Course Syllabus

MATERIALS PHYSICS AND SOLID STATE DEVICES

Class 518

Prof. Aditya D. Mohite; Email: adm4@rice.edu

Office location: Room 225, Space Science & Technology Building

Teaching assistant: Chia Ping Tseng (Andy) : ct43@rice.edu

Course objectives and learning outcomes

The main objective of this course entitled materials physics and solid-state devices is to understand how charge and energy flow in basic semiconductor devices. This course is designed for first or second year graduate students from different disciplines and backgrounds to learn about fundamental concepts that describe the physics of semiconductors all the way from atoms and crystal structure to the workings of solar cells and light emitting diodes. This course is a gateway for graduate students from disciplines (chemical engineers, material science and chemistry) other than ECE and Physics to learn about semiconductor devices and especially for those who will are planning on doing their research on electronic materials and devices. This course is also important for students working on electrochemistry and photoelectrochemistry as they will should be able to take concepts of band-structure, doping, solid-solid junctions and charge transport and extend them to solid-liquid interfaces.

We will focus on three concept areas described below and at the end of the course the students will learn the following concepts:

- Fundamentals of semiconductors: We will begin with fundamental of semiconductors, basic quantum mechanics and solid-state physics for e. g. crystal structure, energy bands, Fermi function), density of states in 1D, 2D and 3D, doping and carrier densities, carrier transport and generation-recombination and semiconductor equations describing electrons and holes.
- Junctions in semiconductors: p-n junctions (electrostatics, I-V curves), metal semiconductor junctions
- Optoelectronic devices: photovoltaics, photodiodes

Grading and exams

Graduate students
Home Works and Quizzes: 40% (best 4 home works and 4 quizzes out of 6 total

will be chosen). Home works are due exactly a week from the assignment date. They should be either handed in class, or to **Chia Ping Tseng (Andy)**.

Midterm: 30% October 11, 2019 from 2:00-2:50 pm
Final exam: 30% Nov 30, 2019 from 2:00-2:50 pm (non-comprehensive).

Note: Depending on the availability of the classroom Keck 107 either before 2 pm or after 2:50 pm, I will increase the time for the mid-terms and finals to 75 mins.

Course Schedule & Syllabus

Fall 2019 Mon-Wed-Fri from 2:00-2:50 pm Room: KECK107

Office hours: Wednesday 3:45-5:45 pm or email me for a different time

Textbooks

Advanced Semiconductor Fundamentals Robert F. Pierret Vol VI (Prentice Hall)

Semiconductor Device Fundamentals by Robert F. Pierret (Addison Wesley)

Reference books

Solid state electronic devices by Ben G. Streetman and Sanjay Banerjee 7th edition (Pearson)

Course policies

Communication: All course information will be communicated via the "announcements" page on canvas. All questions should be e-mailed directly to Professor Aditya Mohite (**adm4@rice.edu**). Scheduled office hours as listed on the syllabus are another excellent opportunity to communicate with the course instructor(s).

Homework: This course has homework assignments designed to master the concepts taught in class. It is important that students keep up with the homework. Late homework will not be accepted. Homework is due in class according to the schedule stated on the syllabus. Homework sets, and solutions will be posted on the course web page or handed in class.

Quizzes: Will be a combination of multiple choice and one-line answers

Collaboration: Collaboration on homework assignments is allowed and encouraged. However, each person must submit a copy of the homework in his/her own handwriting. Please list your collaborator(s) at the top of your homework assignments.

Exams: There will be one mid-term exam and one final exam. A calculator, ruler, and one 8.5” x 11” sheet of notes is allowed for the exam.

Rice Honor Code

In this course, all students will be held to the standards of the Rice Honor Code, a code that you pledged to honor when you matriculated at this institution. If you are unfamiliar with the details of this code and how it is administered, you should consult the Honor System Handbook at http://honor.rice.edu/honor-system-handbook/. This handbook outlines the University's expectations for the integrity of your academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process.

Disability Support Services

If you have a documented disability or other condition that may affect academic performance you should: 1) make sure this documentation is on file with Disability Support Services (Allen Center, Room 111 / adarice@rice.edu / x5841) to determine the accommodations you need; and 2) talk with me to discuss your accommodation needs.

Syllabus Change Policy

This syllabus is only a guide for the course and is subject to change with advance notice.

Course Summary:

Date	Details	
Mon Sep 2, 2019	No class - Labor Day	12am
Fri Oct 11, 2019	MID-TERM EXAM	2pm
Mon Oct 14, 2019	Fall Break	12am
Tue Oct 15, 2019	Fall Break	12am
Wed Oct 16, 2019	NO-class ASU seminar and ACS invited talk	12am
Fri Oct 18, 2019	In-class quiz	2pm to 2:50pm
Wed Oct 30, 2019	In-class quiz	2pm to 2:50pm
Mon Nov 11, 2019	AICHE-No class	12am
Fri Nov 29, 2019	FINAL EXAM	2pm to 2:50pm